

## SPECIES COMPOSITION AND SEASONAL ABUNDANCE OF CARRION BEETLES IN AN OAK-BEECH FOREST IN THE GREAT SWAMP NATIONAL WILDLIFE REFUGE (N.J.)<sup>1</sup>

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**ABSTRACT:** A total of 6066 beetles was collected on carrion in the Great Swamp National Wildlife Refuge from early April to late November, 1979. Represented were 62 taxa, which included 58 species, plus three genera and one subfamily which could not be identified to the species level. Over 99% of the individuals belong to seven families: Silphidae, Nitidulidae, Staphylinidae, Histeridae, Dermestidae, Scarabaeidae, and Leiodidae. With the exception of one scarabaeid, *Serica* sp., all individuals in these seven families were identified to the species level. *Omosita colon* was the most abundant species, making up 35.00% of all beetles, and *Silpha noveboracensis* the second most abundant, accounting for 29.12% of all Coleoptera. A species list by rank order for the top 11 species indicates that these 11 species accounted for more than 92% of all beetles collected on carrion during the eight-month long study.

Species lists of the amphibians, reptiles, birds, and mammals of the Great Swamp National Wildlife Refuge (GSNWR), Basking Ridge, N.J., have been prepared by the biologists at the refuge and are available at the refuge office. With the exception of butterflies, however, nothing has been done about insect species lists for the swamp. Our project was initiated by the senior author for the purpose of (1) determining the species composition and seasonal abundance of carrion beetles in an oak-beech forest in the swamp, and (2) comparing the results with findings in Hutcheson Memorial Forest (HMF), a dry mixed-oak forest near East Millstone, N.J., where a similar study was conducted in 1975 (Shubeck et al., 1977).

The most abundant and conspicuous beetles found on carrion are Silphidae and they are not difficult to identify. Many of the species from other families usually require the assistance of specialists for identification and the senior author was very fortunate to have the services of his co-authors to assist. Dr. N.M. Downie of Purdue University identified all Staphylinidae, Carabidae, and several other difficult taxa. Dr. Rupert L.

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Wenzel of the Field Museum of Natural History, Chicago, identified all Histeridae, and Dr. Stewart B. Peck of Carleton University, Canada, identified all Leiodidae. Several other specialists were helpful in identifying or confirming other taxa, and their names are given in the acknowledgements.

The primary purpose of this study was to determine all species of Coleoptera that were attracted to carrion in a moist oak-beech forest in the GSNWR from the first week of April to the last week of November in 1979.

### Methods

Our collecting station was located in an oak-beech forest about 1 km northeast of refuge headquarters. This forest is situated in the management area which is off-limits to visitors. The beetles were trapped in four No. 10 food cans (3.78 liter), each of which was concealed in a wooden box having 1.27 cm wire mesh at the top and a rain cover above that. These traps have been described elsewhere (Shubeck, 1976). They were placed on the forest floor along a north to south line at intervals of 5 meters. The first and third traps were baited with fish (smelt), and the second and fourth traps were baited with chicken legs (drumsticks). Carrion bait in each trap consisted of three "fresh" fish (about 90 gms total weight) or one "fresh" chicken leg (about 90 gms) in a styrofoam cup (.258 l), and three "stale" fish or one "stale" chicken leg in a styrofoam cup (.258 l).

These traps were initially baited with "fresh" carrion on the first Saturday of April, 1979 and on the second Saturday (when the first collection was made) "fresh" carrion was added to the "stale" carrion. Each trap was serviced once each week, throughout the study, at which time the oldest carrion (and cup) was replaced with fresh carrion (and cup), and all beetles were collected and preserved in jars containing 70% alcohol. At all times, therefore, there were two traps baited with fish, each having fish 1-7 days old (fresh) and fish 8-14 days old (stale), and two traps baited with chicken legs, each having a leg 1-7 days old and one 8-14 days old. This technique (Pirone, 1974) resulted in the presence of fairly uniformly "attractive" carrion on a continual basis.

### Results and Discussion

A total of 6066 beetles was collected in the four carrion-baited traps during the months of April through November in 1979 (Table 1). These beetles represent 62 taxa, which include 58 species, plus three genera and one subfamily which could not be identified to the species level. More than 99% of the individuals belong to seven families which are designated the major families of carrion beetles in the Great Swamp National Wildlife

Refuge. Of the remaining families, two are considered to be minor families and six are considered to be accidental families. Individual numbers of species are given in Table 2. This table shows also the numbers collected during each of the eight months the study was in progress.

**Silphidae:** The most important major family of beetles in the carrion microsera studied was Silphidae, the carrion beetles (Table 2). The 2423 individuals accounted for nearly 40% of all the beetles taken. Of the seven species in the family, *Silpha noveboracensis* was the most numerous, making up almost 73% of the family and over 29% of the order. This species was the second most abundant beetle collected (Table 3). It appears to be bivoltine in the Great Swamp, with a major peak in early May and a second, smaller peak, in early July. The second most abundant silphid, *Silpha americana*, ranked fifth in overall abundance, making up 4.60% of all beetles (Table 3). Well over half of these individuals were taken in July and a quarter in early August. The third, fourth and fifth most abundant silphids were *Silpha inaequalis* (5.74%), *Nicrophorus orbicollis* (5.16%), and *Necordes surinamensis* (2.52%). These species ranked eighth, ninth, and eleventh, respectively, in overall abundance (Table 3). *Silpha inaequalis* was present from the second week of April through the second week of July (during the same period that *S. noveboracensis* was most abundant). The former population, however, peaked in April and declined rapidly thereafter. *Silpha inaequalis* actually ranked second among all beetles in the HMF study where it accounted for virtually 11% of the order. This species may be near its northernmost boundary in N.J. since Pirone did not collect any of these individuals at Armonk, N.Y. which is about 63 km northeast of the Great Swamp. *Nicrophorus orbicollis* was the only silphid species that was present each month of the study and it peaked in August when the three *Silpha* species had declined or disappeared (Table 2). *Necordes surinamensis* also peaked in August.

**Nitidulidae:** The second largest family of beetles was Nitidulidae, the sap-feeding beetles (Table 2). The 2131 specimens accounted for 35.10% of all beetles collected, whereas, in the HMF study they made up but 9.99% of the order. Most significant is the fact that *Omosita colon* actually accounted for all but six of the family members. This amounted to 35% of all beetles, ranking this species in the number one position for Coleoptera (Table 3). In the HMF study *O. Colon* accounted for almost 10% of all beetles with an overall rank of three. It was taken, in Great Swamp, each week from the second week in April to the first week in November (Table 3) and the species peaked in September when the silphids all but disappeared.

Four individuals of the species *Omosita discoidea* were also taken (Table 2). This is probably an introduced species which is occasionally found on carrion with *O. colon* (Parsons, 1943). The former was also collected in very low numbers in HMF, as was the case with *Glischrochilus*

*quadrisignatus* (2 specimens in HMF and 1 in GSNWR). Only one specimen of *Nitidula bipunctata* was taken in this study but according to Connell (personal communication), both *Omosita* and *Nitidula* are the true carrion-feeding genera of the family. They apparently feed on the fluids exuding from the decomposing carrion.

**Staphylinidae:** The third largest family of beetles collected was Staphylinidae, the rove beetles, and the staphylinids accounted for just under 10% of all individuals. This family, however, did exhibit the greatest diversity of species (Table 1). It is interesting to note that in the HMF study this family comprised over 22% of all beetles and more than 36% of all species. It is possible that the very moist soil conditions in the refuge are a limiting factor to the ground-loving staphylinids and, as a result, fewer species and fewer individuals are present. The three most abundant species were *Creophilus maxillosus*; *Aleochara lustrica*, and *Ontholestes cingulatus* and together they accounted for 76.65% of the family, but only 7.62% of the order (Table 2). These three species, none-the-less, were numerous enough to be included in the 11 most abundant carrion beetles in the Great Swamp and they ranked sixth, seventh, and tenth, respectively (Table 3). *Creophilus maxillosus* was present each month of the study but was most abundant in July, August (when it peaked), and September. *Aleochara lustrica* was most abundant from August into October and manifested a pronounced peak in September. *Ontholestes cingulatus* was present from May to November but most abundant from July to September. Staphylinids are active predators on arthropods that are found in the carrion community (Arnett, 1963).

**Histeridae:** Histeridae, the clown beetles, made up the fourth largest family of beetles collected (the position they also held in HMF). In spite of this position, the 398 individuals accounted for less than 7% of all beetles taken. Although 6 species were taken, almost 93% of the individuals consisted of the species *Euspilotus assimilis* (which was also the most abundant species in HMF). The number of these individuals collected ranked the species in the number three position (Table 3). This species appeared in May, increased steadily into July, peaked sharply in August, then all but disappeared during September and October. Histerid beetles, found on carrion are predators on other arthropods present in this microhabitat (Arnett, 1963).

**Dermestidae:** The fifth major family, Dermestidae, the skin beetles, was represented by but one species, *Dermestes caninus*. The 294 individuals accounted for almost 5% of all beetles and in regard to overall species abundance *D. caninus* ranked in fourth place. It was most abundant during the last week of April and the first two weeks of May. During the latter half of May and through June it was present in moderate numbers. Only seven individuals were taken in July, three in August, one in

September, and none thereafter. This well known scavenger usually feeds on animal remains and has been used by zoologists to deflesh skeletons for study (Borror et al., 1975).

**Scarabaeidae:** The sixth major family in this study was Scarabaeidae, the lamellicorn beetles. Although nine species were included in this family, the 90 individuals accounted for less than 1.5% of all beetles (Table 2). *Trox unistriatus* and *Onthophagus hecate* were the more common species collected, together making up more than 76% of all scarabs but little more than 1% of the order. Neither one ranked in the top 11 species of the order. This family accounted for the second greatest diversity of species, exceeded only by the rove beetles. It is a large family of beetles whose many species have adapted to a wide variety of niches. *Trox* spp., for example, are found on dry carrion while *Onthophagus hecate* is a dung feeder and *Onthophagus striatulus* is a fungus feeder (Arnett, 1963). *Geotrupes splendidus*, a large and beautiful (metallic bronze) beetle, is normally found beneath dung and carrion, *Onthophagus orpheus* is found on fungi and carrion, and *Copris* spp. are found on and under dung (Dillon and Dillon, 1961). *Dialytus* spp., according to Arnett (1963), feed by preference on deer droppings. The only scarab species collected that seemed to be completely out of place (on carrion or decomposing animal matter) was *Serica* sp. According to Dr. Brett C. Ratcliffe (personal communication), the latter taxon is made up of foliage feeders and the three individuals were probably trapped accidentally.

**Leiodidae, Catopinae (= Leptodiridae):** The seventh, and last, major family of carrion beetles collected during this study was Leiodidae, subfamily Catopinae (= Leptodiridae, the small carrion beetles). The total number of these individuals taken was only one-fourth of the number of leptodirids taken during the HMF study conducted in 1975. As was the case in that study, *Sciodrepoides fumatus terminans* accounted for better than half of all the family members collected. The 39 individuals, however, accounted for much less than 1% of all beetles and it did not rank in the top 11 species of the order. *Catops simplex* and *Prionochoeta opaca* together made up the bulk of the remaining individuals. The three species mentioned thus far were also the three most abundant leptodirids in HMF. The senior author has often taken these species at carrion; Peck has taken them on human dung (personal communication); and Smith published records of the latter two collected on old store cheese (1910).

The preceding seven families of carrion beetles have been referred to as "major families" for several reasons. (1) Twenty years of field work by the senior author indicated that members of these seven families were consistently associated with carrion. (2) Each of these families, during this study, contributed a minimum of 1% of all beetles taken. (3) Together, these families accounted for 99.05% of all beetles taken.

**Minor Families:** Two families have been designated "minor families." The primary reason for assigning this appellation was the fact that the total number of individuals in each family amounted to less than 1.0% but at least 0.1% of all Coleoptera collected. The secondary reason for the use of this category was the realization that, although the number of individuals collected may have been quite small, the presence of the given individuals might normally be expected on carrion.

Family Carabidae, the ground beetles, are predaceous as larvae and as adults so they very well might be expected to prey upon arthropods found on carrion. The 40 individuals taken in this study represented eight species and .66% of all Coleoptera (Table 2). Although not really abundant, they were much more plentiful when compared with the two carabids taken in HMF. According to Arnett (1963), carabids "are found in large quantities under stones along streams and in moist areas." The oak-beech woodland, where collecting was done, in Great Swamp is much more moist than the mixed-oak woodland in HMF. *Platynus decentis* and *Pterostichus tristis* together accounted for 80% of the 40 carabids taken at Great Swamp.

Family Cleridae, the checkered beetles, are small to medium in size. Most of the species in this family are predaceous on other insects and they are usually found under bark and around flowers (Arnett et al., 1980). There are three species of *Necrobia* that have been introduced into the U.S. (Arnett, 1963), and they are commonly called "ham beetles" but they do not hesitate to feed on carrion "when ham is scarce" (Arnett et al., 1980). All six individuals collected in this study were members of the taxon *Necrobia violacea* (Table 2).

**Accidental Families:** Of the 6066 specimens collected during this eight-month study, 6056 are included in the seven major and two minor families that have been presented thus far. The remaining ten specimens represent eight different species within six additional families. In view of these very small numbers it seems highly likely that most of these ten specimens either accidentally flew, or crawled into the traps. For this reason, the following families are considered "accidental families" in terms of this study.

Family Mycetophagidae, the hairy fungus beetles, was represented by two specimens of *Mycetophagus pluripunctatus* and one of *Typhaea stercorea* L. (Table 2). According to Arnett (1963), "These beetles probably feed exclusively on fungi." The three individuals were taken during the last week of April and the first week of May.

Family Lathridiidae, the minute brown scavenger beetles, was represented by two individuals of one species, *Melanophthalma cavicollis* (Table 2). They were collected in April. Most lathridiids are found in moldy and decomposing plant material (Arnett, 1963).

Family Elateridae, the click beetles, was represented by a specimen of

*Hemicrepidius decloratus* and one of *Ctenicera hieroglyphica* (Table 2). According to Dillon and Dillon (1961) the adults of the latter are predaceous and are found on shrubs and trees.

Family Hydrophilidae, the water scavenger beetles, was represented by one individual of the species *Cryptopleurum minutum* (Table 2). This species is a member of subfamily Sphaeridiinae, whose members are not adapted for swimming but are reported as being associated with carrion or dung (Connell, personal communication).

Family Anobiidae, the drug store and death-watch beetles, was represented by one individual of the species *Lasioderma serricorne* (Table 2). This species is commonly called the cigarette beetle and it usually breeds in stored products such as tobacco and spices (Arnett, 1963).

Family Cryptophagidae, the silken fungus beetles, was represented by one specimen of *Anichicera* sp. (Table 2). Most members of this family "feed on mold, fleshy fungi, decayed leaves and similar materials" (Arnett, 1963).

#### ACKNOWLEDGEMENTS

The senior author would like to thank Mr. John L. Fillio, Refuge Manager of the GSNWR, for permission to work in the Swamp, Mr. Theodore W. Gutzke, Assistant Refuge Manager, provided encouragement, and general information when called on for assistance. Montclair State College provided a substantial contribution for publication charges and the Alumni Association of Montclair State College provided a small grant to partially defray the cost of supplies for the project. We are indebted to the following specialists for assistance in identifying and/or confirming the taxa mentioned: Dr. Walter A. Connell of the University of Delaware - Nitidulidae; Dr. Terry L. Erwin of the Smithsonian Institution - Carabidae; and Dr. Brett C. Ratcliffe of the University of Nebraska - Scarabaeidae.

Table 1. List of families of Coleoptera collected, showing for each the number of individuals trapped and the percentage of the order this represents, also the number of species and the percentage of all Coleoptera species this represents.

Family	Individuals		Species	
	Number	Percent of all beetles	Number	Percent of all beetles
Silphidae	2423	39.92	7	11.26
Nitidulidae	2131	35.10	4	6.43
Staphylinidae	605	9.98	14	22.56
Histeridae	398	6.57	6	9.68
Dermestidae	294	4.85	1	1.62
Scarabaeidae	90	1.49	9	14.52
Leiodidae	69	1.14	4	6.46
Carabidae	40	.66	8	12.91
Cleridae	6	.10	1	1.62
Mycetophagidae	3	.05	2	3.23
Lathridiidae	2	.04	1	1.62
Elateridae	2	.04	2	3.23
Hydrophilidae	1	.02	1	1.62
Anobiidae	1	.02	1	1.62
Cryptophagidae	1	.02	1	1.62
Totals	6066	100.00	62	100.00

Table 2. List of all species (or nearest taxon) trapped on carrion in GSNWR during 1979. Total number of each captured with percentage this is of family and of all beetles is also given.

	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	Total	Percent of Family	Percent of Order
<b>SILPHIDAE</b>											
<i>Silpha noveboracensis</i> Forst.	404	714	254	373	22	—	—	1	1768	72.95	29.12
<i>S. americana</i> L.	3	21	15	166	71	2	2	—	280	11.56	4.60
<i>S. inaequalis</i> Fab.	71	39	26	3	—	—	—	—	139	5.74	2.30
<i>Nicrophorus orbicollis</i> Say	1	20	3	18	59	18	4	2	125	5.16	2.06
<i>Necrodes surinamensis</i> Fab.	—	—	7	9	43	2	—	—	61	2.52	1.01
<i>Nicrophorus pustulatus</i> Hersch.	—	2	15	3	5	1	—	—	26	1.08	.43
<i>Nicrophorus tomentosus</i> Web.	—	—	1	5	11	3	4	—	24	.99	.40
									2423	100.00	39.92
<b>NITIDULIDAE</b>											
<i>Omosita colon</i> (L.)	108	294	281	170	384	763	123	2	2125	99.71	35.00
<i>O. discoidea</i> (Fab.)	2	—	2	—	—	—	—	—	4	.19	.06
<i>Glischrochilus quadrisignatus</i> (Say)	1	—	—	—	—	—	—	—	1	.05	.02
<i>Nitidula bipunctata</i> (L.)	—	1	—	—	—	—	—	—	1	.05	.02
									2131	100.00	35.10
<b>STAPHYLINIDAE</b>											
<i>Creophilus maxillosus</i> (L.)	5	5	19	36	74	32	6	1	178	29.40	2.92
<i>Aleochara lustrica</i> Say	—	3	7	—	21	127	8	—	166	27.41	2.72
<i>Ontholestes cingulatus</i> (Grav.)	—	6	12	23	34	30	11	4	120	19.84	1.98
<i>Aleochara</i> spp.	4	11	2	4	23	10	—	—	54	8.93	.89
<i>Aleochara lata</i> Grav.	10	8	—	2	3	1	4	—	28	4.63	.47
<i>Philonthus politus</i> (L.)	1	—	—	—	14	5	4	—	24	3.97	.40
Aleocharinae	4	6	1	2	1	2	2	2	20	3.31	.33
<i>Omalius rivulare</i> (Payk.)	—	1	—	—	—	—	1	2	4	.67	.07
<i>Staphylinus viridanus</i> Horn	—	—	1	1	1	—	—	—	3	.50	.05
<i>Philonthus lomatus</i> Er.	2	—	—	—	—	—	—	1	3	.50	.05
<i>P. cyanipennis</i> (Fab.)	—	—	—	—	—	—	2	—	2	.33	.04
<i>Quedius capucinus</i> (Grav.)	—	—	—	—	—	—	1	—	1	.17	.02
<i>P. cruentatus</i> Grav.	—	—	—	1	—	—	—	—	1	.17	.02
<i>Carpelimus</i> sp.	—	1	—	—	—	—	—	—	1	.17	.02
									605	100.00	9.98
<b>HISTERIDAE</b>											
<i>Euspilota assimilis</i> (Payk.)	—	22	44	83	214	3	3	—	369	92.69	6.07
<i>Hister depurator</i> Say	—	—	—	—	3	17	1	—	21	5.27	.35
<i>Margarinotus hudsonicus</i> Csy.	1	1	2	1	—	—	—	—	5	1.26	.09
<i>M. cadaverinus</i> (Hoffm.)	—	—	1	—	—	—	—	—	1	.26	.02
<i>H. abbreviatus</i> Fab.	—	1	—	—	—	—	—	—	1	.26	.02
<i>E. conformis</i> (LeC.)	—	—	—	—	1	—	—	—	1	.26	.02
									398	100.00	6.57
<b>DERMESTIDAE</b>											
<i>Dermestes caninus</i> Germ.	68	154	61	7	3	1	—	—	294	100.00	4.85



Percent of Percent of  
APR MAY JUN JUL AUG SEP OCT NOV Total Family Order

## SCARABAEIDAE

<i>Trox unistriatus</i> Beauv.	—	3	6	—	30	8	—	—	47	52.20	.75
<i>Onthophagus hecate</i> Panz.	1	6	4	1	1	4	4	1	22	24.43	.36
<i>Geotrupes splendidus miarophagus</i> Say	—	1	—	1	2	1	2	—	7	7.78	.12
<i>Dialytes striatulus</i> (Say)	—	—	—	—	2	2	—	—	4	4.45	.07
<i>Serica</i> sp.	—	—	3	—	—	—	—	—	3	3.33	.05
<i>Trox hamatus</i> Robinson	—	1	1	—	—	—	—	—	2	2.23	.04
<i>O. orpheus canadensis</i> (Fab.)	—	—	2	—	—	—	—	—	2	2.23	.04
<i>Copris minutis</i> (Drury)	—	—	—	—	—	1	1	—	2	2.23	.04
<i>O. striatulus striatulus</i> (Beauv.)	—	—	—	—	—	—	1	—	1	1.12	.02
									90	100.00	1.49

## LEIODIDAE

<i>Sciodrepoides fumatus terminans</i> LeC.	16	8	1	1	2	6	5	—	39	56.51	.63
<i>Catops simplex</i> Say	9	1	—	—	—	1	7	1	19	27.54	.32
<i>Prionochoeta opaca</i> (Say)	4	—	1	—	1	1	2	—	9	13.05	.15
<i>Dissochaetus oblitus</i> Lec.	—	—	—	—	—	1	1	—	2	2.90	.04
									69	100.00	1.14

## CARABIDAE

<i>Platynus decentis</i> (Say)	—	—	—	1	—	1	14	1	17	42.50	.26
<i>Pterostichus tristis</i> Dej.	—	—	1	—	1	2	11	—	15	37.50	.24
<i>Pinacodera platicollis</i> (Say)	—	—	—	—	—	—	—	2	2	5.00	.04
<i>Pinacodera limbata</i> Dej.	—	—	—	—	—	—	2	—	2	5.00	.04
<i>Pterostichus pennsylvanicus</i> LeC.	—	—	—	—	—	1	—	—	1	2.50	.02
<i>Pterostichus mutus</i> (Say)	—	—	—	—	—	—	1	—	1	2.50	.02
<i>Chlaenius impunctifrons</i> Say	—	—	—	—	1	—	—	—	1	2.50	.02
<i>Platynus cincticollis</i> Say	—	—	—	—	—	—	1	—	1	2.50	.02
									40	100.00	.66

## CLERIDAE

<i>Necrobia violacea</i> (L.)	—	—	—	1	2	3	—	—	6	100.00	.10
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## MYCETOPHAGIDAE

<i>Mycetophagus pluripunctatus</i> Lec.	1	1	—	—	—	—	—	—	2		
<i>Typhaea stercorea</i> L.	1	—	—	—	—	—	—	—	1		

## LATHRIDIIDAE

<i>Melanophthalma cavicollis</i> Mann.	2	—	—	—	—	—	—	—	2		
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## ELATERIDAE

<i>Hemicrepidius decloratus</i> (Say)	—	—	1	—	—	—	—	—	1		
<i>Ctenicera hieroglyphica</i> (Say)	—	—	1	—	—	—	—	—	1		

	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	Total	Percent of Family	Percent of Order
<b>HYDROPHILIDAE</b>											
<i>Cryptopleurum minutum</i> (Fab.)	—	—	—	—	—	—	—	1	1		
<b>ANOBIIDAE</b>											
<i>Lasioderma serricornis</i> (Fab.)	—	1	—	—	—	—	—	—	1		
<b>CRYPTOPHAGIDAE</b>											
<i>Anchicera</i> sp.	1	—	—	—	—	—	—	—	1		

Table 3. The 11 most abundant beetles trapped on carrion in the Great Swamp National Wildlife Refuge during 1979, together with the percentage of Coleoptera each represents, and the family of each. Only those species that contributed a minimum of 1% of all beetles are included. These 11 species actually accounted for 92.63% of all individuals collected.

Species	Percent of Coleoptera	Family
<i>Omosita colon</i>	35.00	Nitidulidae
<i>Silpha noveboracensis</i>	29.12	Silphidae
<i>Euspilotus assimilis</i>	6.07	Histeridae
<i>Dermestes caninus</i>	4.85	Dermestidae
<i>Silpha americana</i>	4.60	Silphidae
<i>Creophilus maxillosus</i>	2.92	Staphylinidae
<i>Allocharya lustrica</i>	2.72	Staphylinidae
<i>Silpha inaequalis</i>	2.30	Silphidae
<i>Nicrophorus orbicollis</i>	2.06	Silphidae
<i>Ontholestes cingulatus</i>	1.98	Staphylinidae
<i>Necrodes surinamensis</i>	1.01	Silphidae

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